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(54) Improved method of signalling
supervisory information in digital
line transmission systems

(57) In a line transmission system
supervisory information is required in
addition to digital information. Nor-
mally a separate transmission channel
is required to transmit this information.
The coding system of this proposal
removes the requirement for an addi-
tional signalling channel. The method
used requires that the line transmission
coding employed should have more
combinations than the coding of the
data to be used (i.e. (2N-1) B→2NB). For
example in optical fibre transmission
systems it is usual to use line codes
such as 3B 4B. In such a coding system
there are 14 zero or 1 bit disparity codes
which are available for mapping onto
the eight "tri-bit" combinations of the
data to be transmitted. Accordingly four
illegal (i.e. unused) code combinations
exist. Selective use of a pair of these
illegal codes for the same pair of tri-bit
combinations can be used to send a one
bit supervisory signal.

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SPECIFICATION**Improved method of signalling supervisory information in digital line transmission systems**

5 The present invention relates to digital line transmission systems and is more particularly concerned with a method of encoding and decoding a digital signal for transmission so that the coder/decoder not only matches the signal to the transmission medium but also directly provides information on the performance of the link (error rate and reframe information being indicated with no additional circuitry).

10 In a line transmission system supervisory information is required as well as transmission of the main digital signal. This is to automatically signal the status of various critical system functions such as error rate etc. Normally a separate transmission path is required to transmit this information. The present invention removes the requirement for an additional signal path or an increase in digit rate whilst allowing the transmission of network control information such as error rate and engineering order wire.

15 According to the invention there is provided a 25 method of handling supervisory information in a digital line transmission system including a transmitter and a receiver, the line transmission system handling a digital information stream formed by a succession of binary information bytes and using a 30 line coding code conversion process in which each

information byte is encoded into a line transmission byte which contains more binary bits than the corresponding information byte and in which the transmitter includes means for controlling the code

35 conversion process for selected information bytes to generate amended line transmission bytes which indicate the state of a supervisory signal in addition to the selected information byte and the receiver includes means for decoding the amended line 40 transmission bytes and for indicating the state of the supervisory signal in addition to the selected information byte.

The method requires that the coding used should have sufficient illegal (or unused) combinations in 45 the line code to enable use to be made of them in transmitting the additional two state supervisory information. The invention is particularly applicable (but not limited) to transmission over optical fibres where line code conversion to codes of the form 50 $(2n-1)B/2nB$ (where $n > 1$) are used.

An example will now be given using 3B/4B code conversion i.e. 3 binary digit information bytes which are replaced by 4 binary digit line transmission bytes.

55 The incoming binary data and signal is first scrambled to ensure that the required 'tri-bits' (i.e. groups of 3 bits) all occur with sufficient frequency for the supervisory signal to be carried. The resulting data stream is then coded for transmission to line 60 using the following encoding table:—

	IB(3B)	LTB(4B)	Supervisory Signal
		Disparity	
65		0000 illegal word	
	000	0001	-2
	111	0010	-1
	001	0011	-1
		0100 illegal word	0
		010	0
	(011	0110	0
	(011	0111*)	+1
	() were	0
	(100	1000*) illegal	-1
	(100	1001	0
	101	1010	1
		1011 illegal word	0
	110	1100	0
	000	1101	+1
	111	1110	+1
80		1111 illegal word	+2

The 4 bit line transmission bytes starred were so-called 'illegal' i.e. unused bytes. By using two of the otherwise unused 4 bit output bytes as illustrated above supervisory and order wire information may be transmitted as follows with no effect on the main data path:—

85 (a) when a supervisory signal "1" is to be transmitted

90 011 is encoded as 0110

and 100 is encoded as 1001

95 (b) when a supervisory signal "0" is to be transmitted

011 is encoded as 0111

95 and 100 is encoded as 1000

The coding changes are detected by the decoder at the receive end of the system and easily separated as a lower speed digital data path independent of the main data signal.

100 The alternative method of incorporating a supervisory signal is to increase the bit rate of the main data signal and using a multiplexor to introduce the supervisory.

Where line coding has to be introduced for other 105 reasons e.g. $(2n-1)B \rightarrow 2nB$ coding the proposed method requires no increase in bit rate.

CLAIMS

1. A method of handling supervisory information in a digital line transmission system including a

transmitter and a receiver, the line transmission system handling a digital information stream formed by a succession of binary information bytes and using a line coding code conversion process in
5 which each information byte is encoded into a line transmission byte which contains more binary bits than the corresponding information byte and in which the transmitter includes means for controlling the code conversion process for selected information bytes to generate amended line transmission bytes which indicate the state of a supervisory signal in addition to the selected information byte and the receiver includes means for decoding the amended line transmission bytes and for indicating the state of
10 15 the supervisory signal in addition to the selected information byte.

2. A method of handling supervisory information in a digital line transmission system according to claim 1 in which the line coding code conversion
20 process uses a code of the form $(2n-1)B/2nB$ (where $n > 1$).

3. A method of handling supervisory information in a digital line transmission system according to claim 2 in which at least one of the information bytes
25 is allocated two line transmission bytes arranged to be selected for transmission in accordance with the 1 or 0 state of the supervisory signal when the one information byte is to be transmitted.

4. A method of handling supervisory information
30 in a digital line transmission system substantially as herein before described.

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